



Algebraic Equations

Introduction	This guide will tell you what you need to know to solve equations. Before we start you need to know a few things beforehand (see below).	The example problem we'll be using below is very complex and contains all the different situations you'll come upon when solving equations. If you can solve a problem like this one, you're on your way to becoming a math master!
Math Facts	It is VERY important that you know your math facts (also known as multiplication tables) backwards and forwards to solve equations.	$2 \times 2 = 4$ $4 \div 2 = 2$ $4 \times 7 = 28$ $28 \div 7 = 4$ $9 \times 9 = 81$ $81 \div 9 = 9$
Variable	<p>You need to know what a variable is. A variable is the "unknown" in an equation or inequality and is usually represented by a letter.</p> <p>The goal in an equation or inequality is to find the value of the variable which makes the solution true.</p>	<p>$5 + n = 9$ is an equation in which "n" is the variable. In this case, replacing "n" with the number "4" makes this equation true.</p> <p>$5 + n > 9$ is an inequality in which "n" is the variable. In this case, replacing "n" with ANY number "5 or higher" makes this inequality true.</p>
Adding Positive & Negative Numbers	<p>Adding 2 positive numbers gives you a larger positive number</p> <p>Adding 2 negative numbers gives you a larger negative number.</p> <p>Adding a positive number to a negative number could give you a positive OR negative answer depending on which one is bigger.</p>	<p>$4 + 5 = 9$ (adding these 2 numbers together results in a larger positive number).</p> <p>$-4 + -5 = -9$ (adding these 2 numbers together results in a larger negative number).</p> <p>$5 + -4 = 1$ (positive number is bigger than negative number....positive answer).</p> <p>$-5 + 4 = -1$ (negative number is bigger than positive number....negative answer).</p>
Subtracting Positive & Negative Numbers	<p>Subtracting positive and negative numbers can give you a positive OR negative number answer depending on the size of the numbers and their order.</p> <p>When solving equations the wise thing to do is to change subtraction problems to addition problems to make them easier to solve (see the example to the right).</p>	<p>$15 - 5 = 10$ is the same as..... $15 + -5 = 10$ all you've done is changed the problem from subtraction to addition and made the second number negative ("the opposite").</p> <p>$15 - (-5)$ can also be changed to an addition problem but in this case the -5 would become positive 5 (the opposite of -5). $15 + +5 = 20$</p>

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Multiplying & Dividing Positive & Negative Numbers	<p>Multiplying or dividing 2 positive numbers by each other always gives you a positive answer. (2 positives make a positive)</p> <p>Multiplying or dividing 2 negative numbers by each other always gives you a positive answer (2 negatives make a positive)</p> <p>Multiplying or dividing a positive number and a negative numbers always gives you a negative answer. (1 positive and 1 negative make a negative)</p>	$4 \times 6 = 24$ $24 \div 6 = 4$ $-4 \times -6 = 24$ $-24 \div -6 = 4$ $4 \times -6 = -24$ $-24 \div 6 = -4$
Like Terms	<p>When solving equations you need to know how to combine “like” terms. This means combining variables with other like variables and numbers with other numbers. (see example)</p>	<p>Example: $2d + 3d + 4d - d = 1 \times 4 + 5 - 1$ Combine like terms (variables) $2d + 3d + 4d - d = 1 \times 4 + 5 - 1$ Becomes $8d = 1 \times 4 + 5 - 1$ Combine like terms (numbers) $8d = 1 \times 4 + 5 - 1$ $8d = 8$</p>
Distributive Property	<p>This math rule allows you to distribute or “give” a number being multiplied to any numbers inside parentheses that are being added or subtracted.</p>	<div style="text-align: center;">  </div> <p>Multiplication over addition example $4(D + 4)$ becomes $4D + 4 \times 4$</p> <div style="text-align: center;">  </div> <p>Multiplication over subtraction example $8(4 - D)$ becomes $8 \times 4 - 8D$</p>
Order of Operations	<p>After using the distributive property above, now you would follow the order of operations. This is the order of mathematical operations.</p> <p>(parentheses, exponents, multiplication & division, addition & subtraction) That can be hard to remember so use the tips to the right.</p>	<p>Remember the phrase “Please Excuse My Dear Aunt Sally”. (PEMDAS) The first letter of each word stands for a math term.</p> <p>The ‘P’ in Please stands for parenthesis. The “E” in Excuse stands for exponents. The “M” in my stands for multiplication. The “D” in Dears stands for division. The “A” in Aunt stands for addition. The “S” in Sally stands for subtraction.</p>

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Solve the Equation

Now we're going to solve a very long and complicated equation using everything we know and after that we'll check our work.

If you can follow the steps to solve a problem like this you can solve any equation! Our goal is to get the variable by itself.

Before we solve the problem we need to simplify it using the steps below.

Step 1 ~ "P" for Please (parenthesis) using the distributive property in bold to get rid of the first set of parentheses.

Now we'll eliminate the other set of parenthesis.

Step 2 ~ "E" for Excuse (exponent). We'll solve 4 to the power of 2.

Step 3 ~ "M,D" for My Dear (multiplication & division).

These are twin brothers that you solve together going from left to right.

Step 4 ~ "A,S" for Aunt Sally (addition & subtraction).

These are twin sisters that you solve together going from left to right.

This is also where we'll be combining like terms starting with the variables (adding and subtracting).

Now we'll combine like terms (numbers) by adding and subtracting.

Here's our example:

$$4(D + 4) + 2D - 4^2 + 2 = (4 + 4) \div 4 + 2D + 5 \times 1 - 1$$



$$4(D + 4) + 2D - 4^2 + 2 = (4 + 4) \div 4 + 2D + 5 \times 1 - 1$$

Becomes $4D + 4 \times 4 + 2D - 4^2 + 2 = (4 + 4) \div 4 + 2D + 5 \times 1 - 1$

$$4D + 4 \times 4 + 2D - 4^2 + 2 = (4 + 4) \div 4 + 2D + 5 \times 1 - 1$$

Becomes $4D + 4 \times 4 + 2D - 4^2 + 2 = 16 \div 4 + 2D + 5 \times 1 - 1$

$$4D + 4 \times 4 + 2D - 4^2 + 2 = 16 \div 4 + 2D + 5 \times 1 - 1$$

Becomes $4D + 4 \times 4 + 2D - 16 + 2 = 16 \div 4 + 2D + 5 \times 1 - 1$

$$4D + 4 \times 4 + 2D - 16 + 2 = 16 \div 4 + 2D + 5 \times 1 - 1$$

Becomes $4D + 16 + 2D - 16 + 2 = 4 + 2D + 5 - 1$

$$4D + 16 + 2D - 16 + 2 = 4 + 2D + 5 - 1$$

Becomes $6D + 16 - 16 + 2 = 4 + 2D + 5 - 1$

$$6D + 16 - 16 + 2 = 2D + 5 - 1$$

Becomes $6D + 2 = 2D + 4$

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<p>Step 5 ~ We've totally simplified the problem and now we're going to solve it. The goal is to get all the variables on one side of the = sign and the numbers on the other side.</p> <p>The variable goes first. Always eliminate the smallest one by calculating its' opposite. Whatever you do to one side of the equation, you MUST do to the other side.</p> <p>We decided to eliminate the variable on the right side of the equation that means that now we have to eliminate the number on the left (opposite) side of the equation. Once again, whatever we do to one side of the equation, we must do to the other side.</p> <p>Finally we have to get the variable (in this case "D") alone. In our problem it's being multiplied by 4 which means we need to do the opposite – divide by 4 and of course whatever we do to one side of the equation, we must do to the other side.</p>	$\begin{array}{r} 6D + 2 = 2D + 4 \\ -2D \quad -2D \\ \hline 4D + 2 = 4 \end{array}$ $\begin{array}{r} 4D + 2 = 4 \\ -2 \quad -2 \\ \hline 4D = 4 \end{array}$ $\begin{array}{r} 4D = 4 \\ \div 4 \quad \div 4 \\ \hline 1D = 1 \end{array}$ <p>which really means that our final answer is....</p> <p>D = 1</p>
<p>Check Your Work</p> <p>How do we know our answer is right?</p> <p>Simple, we check our work by going back to the original problem and replace all the variables ("D") with our answer "1".</p> <p>We'll use the same Order of Operations we used to solve the problem.</p> <ol style="list-style-type: none"> 1. "P" as in "Please" (parenthesis) 2. "E" as in "Excuse" (exponents) 3. "M,D" as in "My Dear" (multiplication AND division – the twin brothers which you solve in order from left to right. 4. "A,S" as in "Aunt Sally (addition AND subtraction – the twin sisters which you solve in order from left to right. <p>When you check your work and find that the final answer has the same number on both sides of the equals sign it PROVES that you've solved the equation correctly!</p>	<p>$4(\mathbf{D} + 4) + 2\mathbf{D} - 4^2 + 2 = (4 + 4) \div 4 + 2\mathbf{D} + 5 \times 1 - 1$</p> <p><i>Using the original equation replace the variable with your solution</i></p> <p>$4(\mathbf{1} + 4) + 2 \times \mathbf{1} - 4^2 + 2 = (4 + 4) \div 4 + 2 \times \mathbf{1} + 5 \times 1 - 1$</p> <p><i>"P" as in "Please" (parenthesis)</i></p> <p>$4(\mathbf{1} + \mathbf{4}) + 2 \times 1 - 4^2 + 2 = (\mathbf{4} + \mathbf{4}) \div 4 + 2 \times 1 + 5 \times 1 - 1$ becomes...</p> <p>$4 + \mathbf{16} + 2 \times 1 - 4^2 + 2 = \mathbf{8} \div 4 + 2 \times 1 + 5 \times 1 - 1$</p> <p><i>"E" as in "Excuse" (exponents)</i></p> <p>$4 + 16 + 2 \times 1 - \mathbf{4}^2 + 2 = 8 \div 4 + 2 \times 1 + 5 \times 1 - 1$ becomes.....</p> <p>$4 + 16 + 2 \times 1 - \mathbf{16} + 2 = 8 \div 4 + 2 \times 1 + 5 \times 1 - 1$</p> <p><i>"My Dear" (multiplication AND division)</i></p> <p>$4 + 16 + \mathbf{2} \times \mathbf{1} - 16 + 2 = \mathbf{8} \div \mathbf{4} + \mathbf{2} \times \mathbf{1} + \mathbf{5} \times \mathbf{1} - 1$ becomes....</p> <p>$4 + 16 + \mathbf{2} - 16 + 2 = \mathbf{2} + \mathbf{2} + \mathbf{5} - 1$</p> <p><i>"Aunt Sally (addition AND subtraction)</i></p> <p>$4 + \mathbf{16} + \mathbf{2} - \mathbf{16} + \mathbf{2} = \mathbf{2} + \mathbf{2} + \mathbf{5} - \mathbf{1}$ becomes.....</p> <p>8 = 8!</p>

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